

ICHTHYOLOGY:—*Garmannia zebrella*, a new gobiid fish from Trinidad, with notes on the species of the subgenus *Tigrigobius* Fowler.¹ C. RICHARD ROBINS, Marine Laboratory, University of Miami. (Communicated by E. A. Lachner.)

(Received March 24, 1958)

Recently the writer and James E. Böhlke compared some gobiid fishes from Florida, the Bahamas, and other stations in the Gulf and Caribbean. It was apparent that the name *Garmannia macrodon* (Beebe and Tee-Van) had been applied to two distinct but closely related species, the second of which is described below as new.

Apart from the original descriptions little additional information has been forthcoming on *Garmannia macrodon* and *G. pallens* Ginsburg. Recent collections in the Florida Keys enable the writer to provide descriptive and behavioral notes on *macrodon*.

For the loan of material and for helpful information and many kindnesses received at their respective institutions I am indebted to James E. Böhlke of the Academy of Natural Sciences of Philadelphia and Leonard P. Schultz of the United States National Museum. Giles W. Mead, Ernest A. Lachner, and Robert H. Kanazawa have aided me in many ways during my visits to the National Museum. I am especially indebted to Isaac Ginsburg for advice and for providing unpublished data on *G. pallens*.

This study represents a portion of the work supported by the National Science Foundation (NSF-G-3881) and constitutes a technical report to that organization. The writer gratefully acknowledges this assistance.

Garmannia zebrella, n. sp.

Fig. 1, Tables 1-2

?*Gobiosoma multifasciatum*, Metzelaar, 1919: 139 (misidentification; for account of this record see Ginsburg, 1933: 55). ?Koumans, 1931: 53 (apparently based on Metzelaar's material).

Gobiosoma macrodon, Fowler, 1931: 401 (misidentification; characters in part, incorrectly described). Ginsburg, 1933: 53 (in part: Curaçao records probably referable to *zebrella*).

Material examined.—The holotype, ANSP 53387 (standard length, 21.0 mm) and two

paratypes, ANSP 53388 and ANSP 53389 (standard lengths 16.1 and 15.5, respectively) were collected at Monos Island, Trinidad, on June 27, 1950, by L. Wehekind.

Diagnosis.—In preservative, a straw-colored goby with 13 prominent and sharply defined dark brown bands on the body behind the pectoral fin. Six additional bands in front of the pectoral fin. Body naked with a few modified ctenoid scales at the caudal base and on the posterior portion of the body. Spinous dorsal of seven elements, the first filamentous. Distance between spines 5 and 6 and 6 and 7 much greater than between any of the first five spines. Dark bands fairly broad, subequal to the light-colored interspaces. Two large and very prominent canines in anterior portion of inner row of teeth on the lower jaw.

Description.—Thirteen dark brown bands cross the body behind the pectoral fin. They are arranged as follows: the first crosses the dorsum in front of the insertion of the dorsal fin but not in contact with it. This band slopes slightly caudad to pass immediately behind the insertion of the pectoral fin. It is not continued across the midline of the belly but a faint suggestion is present on each side of the base of the pelvic disc at a point opposite the lower end of the band. The next three bands pass through the base of the spinous dorsal and each is represented by an adjacent dark squarish mark in the fin membrane. These three bands, as well as all posterior ones, become thinner and somewhat less distinct on the venter. The first of group of three bands does not cross the mid-ventral line but the others do although the mid-ventral portion is poorly defined. Five bands pass around the body through the base of the second dorsal fin in a manner similar to those under the first dorsal. A square blotch, fused to the band, extends for some distance upward in the fin membrane. The first of these five bands circles the belly just behind the genital papilla and in advance of the anal-fin insertion. Three of the remaining four circle the belly under the anal-fin base and the fourth passes just caudad

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TABLE 1.—FREQUENCY DISTRIBUTIONS OF FIN-RAY COUNTS IN *GARMANNIA MACRODON* AND *GARMANNIA ZEBRELLA*

Species	Dorsal spines		Dorsal rays		Anal rays			Pectoral rays				Caudal rays	
	VI	VII	11	12	9	10	11	16	17	18	19	16	17
<i>G. macrodon</i>	1	41*	34*	8	3	36*	3	4	69*	11	—	4	37
<i>G. zebrella</i>	—	3	2	1	—	3	—	—	—	4	2	—	3

TABLE 2.—FREQUENCY DISTRIBUTIONS OF BODY PROPORTIONS EXPRESSED IN HUNDREDTHS OF STANDARD LENGTH

Species and size range in millimeters	Head length									Eye diameter									
	26	27	28	29	30	31	32	33	34	5	6	7	8	9	10				
<i>G. macrodon</i> :																			
>30	1	—	—	1	—	—	—	—	—	1	1	—	—	—	—				
25-29	—	1	5	4	3	2	—	—	—	—	5	8	1	—	—				
20-24	—	—	2	1	3	3	—	—	—	—	—	3	4	1	—				
<20	—	1	2	1	6	3	1	1	1	—	—	1	6	7	3				
<i>G. zebrella</i> :																			
16-21	—	—	—	—	2	1	—	—	—	—	—	—	2	1	—				
	Prevent									Depth at vent									
	54	55	56	57	58	59	60	61	62	63	18	19	20	21	22				
<i>G. macrodon</i> :																			
>30	—	—	1	1	—	—	—	—	—	—	—	—	—	—	2				
25-29	—	1	3	6	—	3	1	—	—	2	—	2	3	5	4				
20-24	—	—	—	2	2	3	1	—	—	—	—	1	2	4	2				
<20	1	—	—	2	2	3	5	—	—	1	1	1	3	5	5				
<i>G. zebrella</i> :																			
16-21	—	—	—	—	1	—	—	2	—	—	—	—	—	2	1				
	Length of pectoral fin									Depth at nape									
	25	26	27	28	29	30	31	32	33	34	20	21	22	23	24				
<i>G. macrodon</i> :																			
>30	—	2	—	—	—	—	—	—	—	—	1	—	1	—	—				
25-29	2	2	2	3	1	3	—	—	—	—	2	2	9	1	—				
20-24	—	2	2	—	2	1	—	—	—	1	—	2	4	2	—				
<20	—	—	—	1	1	2	4	1	2	—	4	5	5	2	1				
<i>G. zebrella</i> :																			
16-21	1	—	—	—	—	1	—	—	—	1	—	2	1	—	—				
	Predorsal length									Length of pelvic fin									
	31	32	33	34	35	36	37	38	39	19	20	21	22	23	24	25	26	27	28
<i>G. macrodon</i> :																			
>30	—	1	—	1	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—
25-29	1	—	1	1	5	4	2	—	—	1	5	4	3	—	—	1	—	—	—
20-24	—	—	1	2	1	3	1	1	—	—	—	2	3	1	2	—	—	—	—
<20	—	—	—	3	3	3	3	3	1	—	1	2	2	3	3	3	1	—	1
<i>G. zebrella</i> :																			
16-21	—	—	—	2	—	—	1	—	—	—	—	—	1	—	1	—	1	—	—

of the insertion of the last anal ray. All are well defined ventrally. Two bands circle the caudal peduncle and do not contact any fin. The twelfth of the thirteen bands on the body behind the pectoral fin circles the body through several anterior procurent caudal rays. The final band is incomplete on the dorsal and ventral surfaces and extends as a vertical bar external to the posterior edge of the hypural plate and thus near the bases of the main caudal rays.

Six bands are present in advance of the pectoral fin making 19 bands in all on the fish. The first, a single medium band, extends from the tip of the snout across the upper lip (not visible on Fig. 1). It continues after a slight gap on the lower lip and ends on the mid-gular region. The second band begins medial to and slightly behind the posterior nostril and continues downward and forward across the medial surface of the tubular anterior nostril, across the upper lip, and onto the lower lip. It is interrupted here but continues caudad across the branchiostegal membranes in somewhat irregular fashion. Band three is almost semicircular in outline; starting on the midline of the nape and then splitting to both sides, it extends onto the upper surface of the eye, continues downward across the anterior margin of the eye and then caudad across the posterior end of the maxillary where it ends. A slight mark on the lower cheek and another on the branchiostegal membranes represent its continuation. The band actually splits on the upper edge of the eye to form a small open circle but owing to the dark pigment of the eye this is not easily seen. Bands four and five cross the back in semicircular fashion, the open side of the bow being forward. Band four extends forward and ventral across the posterior edge of the eye where it may be interrupted, and then crosses the cheek. Band five is much broader than bands one to four and nearly as broad as those on the body. It crosses the side of the head behind the eye and terminates on the lower edge of the interopercle. The last of the bands anterior to the pectoral fin crosses the dorsum as a straight line and extends downward through the opercular membrane to end at the insertion of the lowermost pectoral ray.

The width of the dark bands is diagnostic for the species, the dark areas being only slightly narrower than the intervening pale area. The combined width of the 2 dark bands far exceeds the width of the intervening light-colored one.

All fin membranes are liberally covered with melanophores. Frequency distributions of fin-ray counts and of morphometric data are given in Tables 1 and 2. All three specimens possess seven dorsal spines. Spines 1 to 5 are evenly spaced and the first is filamentous. The space between spines 5 and 6 is twice that between any of the preceding rays and spine 7 is only a little less distant from spine 6, the gap being about one and one-half times that between any of the first five spines. There are 11 or 12 dorsal and 10 anal rays. Total caudal elements number 28 or 29 (procurent elements included). Of them, 17 are cross striated in all three specimens. There are 18 or 19 pectoral rays. Each pelvic fin consists of one spine and five rays, the two fins joined to form the typical gobiid disc. The disc is free from the body. A frenum is well developed and heavy, firmly uniting the two pelvic spines and forming a pocket across the anterior end of the disc. The anal fin is inserted under the third dorsal ray.

The body is nearly scaleless. Four modified ctenoid scales are evenly spaced at the base of the caudal fin and a patch of from 9 to 12 ctenoid scales are present on the sides of the caudal peduncle between the tenth and twelfth dark bands.

A broad patch of depressible teeth is present on the dentary. The outer row is directed slightly forward and its teeth are somewhat larger and flatter than those of the other rows. The dentary patch is broad across the region of the symphysis but tapers rapidly along the sides of the jaw. About midway along these projections are two large recurved fangs, one on the inner and outer edge of each process. The premaxillary teeth are similar but the patch is not so broad anteriorly as that of the dentary. Its outer row is similarly enlarged and directed forward. The tooth patch narrows considerably but reaches the end of the maxillary process of the premaxillary. At its tip are one or two fangs, not so large as those in the lower jaw but nonetheless conspicuous.

The gill opening is restricted; its origin is opposite the second pectoral ray, its lower extreme just below and forward of the last pectoral ray. There are 8 gill rakers on the holotype, one on the upper and seven on the lower limb.

Range.—*G. zebrella* is known only from the type locality, Monos Island, Trinidad.

Name.—The diminutive of *zebra* in reference to the banded color pattern.

Garmannia macrodon (Beebe and Tee-Van)

Fig. 1, Tables 1-2

Gobiosoma macrodon Beebe and Tee-Van, 1928: 226 (figure, description).

Garmannia macrodon, Ginsburg, 1933: 53-55 (Synonymy in part, characters, relationships). Ginsburg, 1939: 63 (related to *Garmannia pallens*). Fowler, 1941: 96 (recorded from Sanibel Island, southwest coast of Florida). Ginsburg, 1944: 379 (placed in subgenus *Tigri-gobius* of *Garmannia*).

G. macrodon is described in some detail by Ginsburg (1933: 53-55) and only a few features need be discussed here. Fin-ray counts and morphometric data are presented in Tables 1 and 2. Since some body proportions vary with specimen size, these data are arranged by size classes. Of 41 specimens examined 37 had 17 cross-striated caudal rays and 4 had 16. The bands on the body are arranged precisely as

that described for *zebrella*. The dark bands are narrow, their width being less than one-third of the pale interspace. The second band behind the eye is bowed on the dorsal surface of the head. In life the dark bands have a maroon cast and at least during the winter months the elongate first dorsal spine is yellowish.

The gill opening is restricted, its width only slightly exceeds the width of the pectoral base. The gill rakers are short and stubby and usually number $1 + 7$, the uppermost on the lower limb being near the angle. Counts for five specimens are: $1 + 7(3)$, $1 + 8(1)$, $2 + 7(1)$.

A black streak extends along the dorsal-fin membrane about one-third of the distance from the base to the fin edge. The distal two-thirds of the caudal fin and the entire pelvic disc are largely dark. The anal fin is dark except for narrow basal and distal stripes. Four ctenoid scales are present at the caudal base in all in-

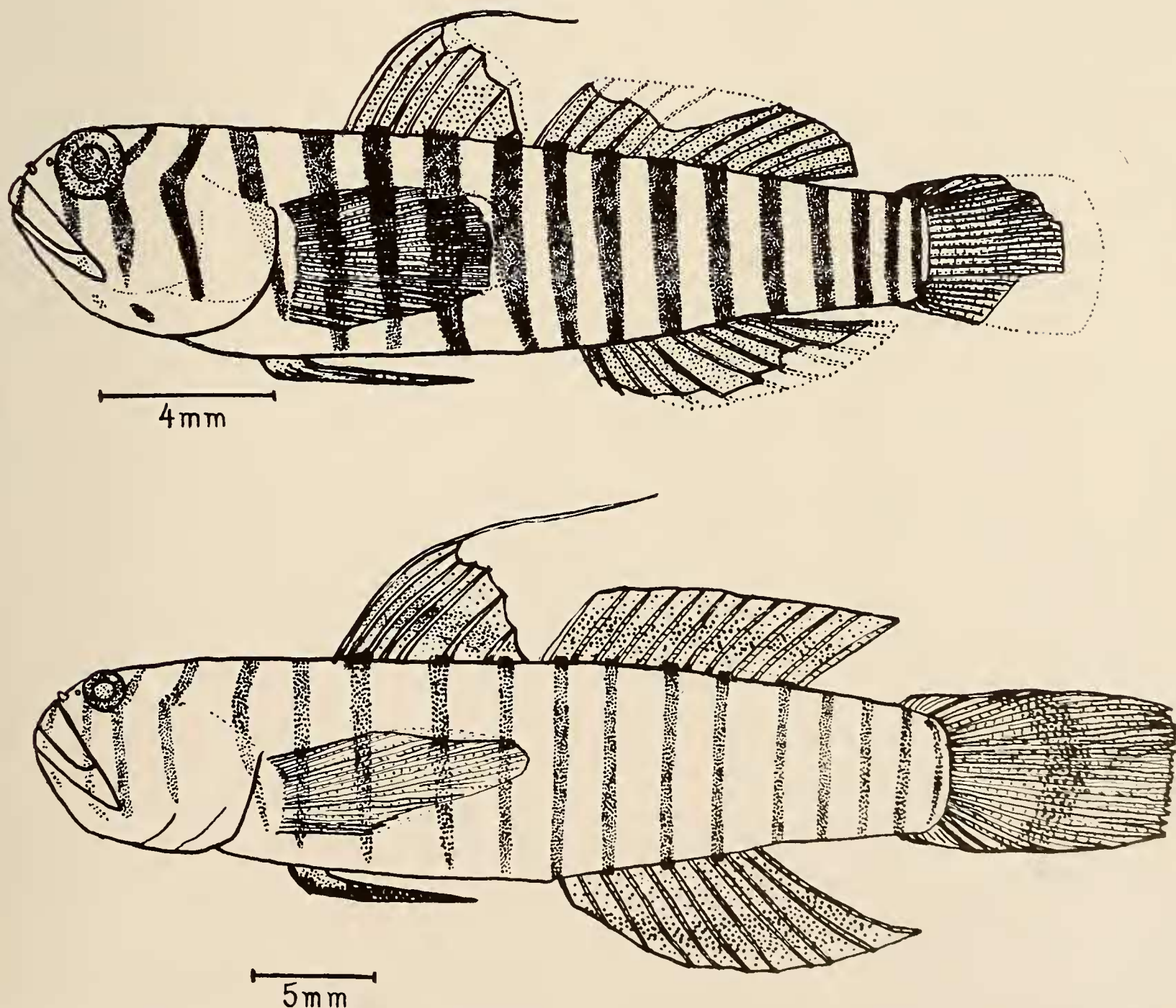


FIG. 1.—Upper: Lateral view of the holotype of *Garmannia zebrella*, ANSP 53387 (1, 21) from Monos Island, Trinidad. Lower: Lateral view of an adult *Garmannia macrodon*, UMMIL 873 (1, 37) from Dinner Key at Miami, Fla. (The figures are to show the diagnostic color patterns and general body form. The fine structure of the fins are generalized and such details as the scales on the caudal peduncle are omitted.)

dividuals examined but the remainder of the squamation varies. Usually there are four or five scales on the posterior portion of the caudal peduncle, most below the midline.

During January 1957 this species was observed in the Florida Keys on the bay side of Crawl Key where a deep quarry nearly a quarter mile across and more than 50 feet deep had been dug years before. The quarry is broadly connected over a shallow sill to the ocean. It has stabilized and supports a rich tropical fish fauna. In the winter little algal growth occurs on the rock sides and silted rubble bottom. At this time two gobiid fishes, *Coryphopterus glaucofrenum* Gill and *Garmannia macrodon* abounded. The bridled goby, *C. glaucofrenum* is found on the terraces from 5 to 20 feet below the surface, always lying near a hole or the side of a rock into or under which it can retreat. *G. macrodon* perches on top of the rocks in the same depth range, swimming along their surfaces in the manner characteristic of the neon gobies (*Elecatinus*). Despite their prominent bands they are difficult to perceive. No collections were made at this time.

When the same area was revisited on October 12, 1957, by Raymond B. Manning and myself, *C. glaucofrenum* was still in its usual haunts but no *Garmannia* could be found after extended survey. A third goby, *Barbulifer ceuthoecus* (Jordan and Gilbert) was observed at Crawl Key on this occasion, usually in water less than one foot deep. Here on well silted rubble bottom it occurs under the rocks and is never numerous. It avoids the vertical walls and at least in our experience does not ecologically overlap either *Coryphopterus* or *Garmannia*.

The vertical rock ledges were covered by a dense net of algae, pale reddish but somewhat variegated in color. A cloud of rotenone was released along this algal mat from the surface to 15 feet. Every few feet along the poisoned wall, between a depth range of 5 and 15 feet *Garmannia* emerged, usually in pairs, one large and one small individual. In general these proved to be males and females; the latter apparently rarely exceed 20–22 millimeters in standard length. None were found away from the algae or even on the non-vertical portions of the rock wall. No nests or eggs could be found in the loose mat which was extensively tunneled. *G. macrodon* seemed very disturbed when placed away from the wall. They swam in circles and were unable to return even when only a yard or two from the

wall. When taken out over deep water (down a few feet from the surface) they completely lost their orientation and swam in tight gyres. Often they were upside down. This erratic behavior ceased when we placed a hand to the goby. Immediately it regained its orientation and swam over and under it always with its ventral surface closely appressed to the surface. Thus it would be upside down on the lower side just as it moves along its more normal rock and algal haunts. Apparently *macrodon* depends completely on contact with the substrate and loses orientation when such is not available.

A specimen from off Dinner Key at Miami, Fla. (UMML 873) was supposedly taken from a fire sponge (*Tedania*). This may have been an unusual circumstance for the species has not been noted among the material collected from sponges in our field program.

The holotype recorded by Beebe and Tee-Van (1928: 226) as no. 7462 in the Tropical Research Collection of the New York Zoological Society is now at the United States National Museum (USNM 170896).

Range.—*G. macrodon* is known from Sanibel Island (Fowler, 1941: 96) on the southwest coast of peninsular Florida and Dinner Key at Miami on the southeast coast southward through the Florida Keys. Elsewhere it is recorded from Port-au-Prince Bay, Haiti (Beebe and Tee-Van, 1928: 226–227). Its supposed occurrence in Curaçao needs verification for Metzelaar's (1918: 139) record would seem applicable to *zebrilla*.

Material examined.—Haiti: USNM 170896 (1, 29) HOLOTYPE. Florida: UMML 873 (1, 37), Dinner Key, Miami; UMML 1612 (99, 16–31) ANSP 79168 (10, 20–28), Crawl Key, Florida Keys; USNM 73094 (2, 18), USNM 73096 (1, 21), USNM 57410 (1, 29), USNM 73095 (1, 25), USNM 93745 (2, 16–19), USNM 73093 (1, 20), USNM 118168 (2, 14–17) all from various localities in the Florida Keys.

***Garmannia (Tigriobius) pallens* Ginsburg**

Garmannia pallens Ginsburg, 1939: 63 (original description). Ginsburg, 1944: 379 (placed in subgenus *Tigriobius*, compared with *macrodon*).

Ginsburg's (1939: 63) brief account of *G. pallens* anticipated a fuller description in a later monograph which unfortunately has never been published. Reexamination of the holotype, USNM 107327 (1, 12) reveals a badly faded specimen in rather poor condition. Only ten

bands are still discernible behind the pectoral base. The band immediately behind the eye is semicircular in outline but the next is nearly straight. The anterior nostril is tubular. The following diagnosis, from Mr. Ginsburg's unpublished files may facilitate its identification.

Diagnosis.—Anterior part of body naked; posterior part scaled, the scales imbricated; scales extending forward to under bases of sixth to eighth dorsal rays, in about 9–12 oblique rows; anterior bare areas above and below tapering to a little behind base of dorsal and anal; 4 scales in row on caudal (scales partly missing and above statements subject to correction). First spine of male prolonged, reaching to base of fourth ray, not prolonged in female. Dorsal rays 11; anal rays 9 (same count in 2 specimens); pectoral rays 15 or 16. Head well compressed. Maxillary reaching slightly past posterior margin of eye in male, to under posterior margin of pupil in female.

Ground color light yellowish, crossed by narrow dark bands, narrower than the interspaces, the bands rather faint as compared with *macrodon*; 13–14 bands from base of pectoral to that of caudal, 3 or 4 of the bands in scattered positions confined to a short distance at the dorsal profile; 3 bands on head behind eyes confined to dorsal aspect; bands on head and anterior part of body fainter than posterior ones; in female bands in general still fainter than those in male, those on head and anterior part of body nearly obsolescent; a very fine, faint, somewhat interrupted, longitudinal, median streak on posterior part of body; male with a dark somewhat elongate spot under eye, near its posterior margin, and a more diffuse dark streak running obliquely from directly under middle of eye to posterior end of maxillary.

Discussion.—The three species currently assigned to *Tigrigobius* form a closely knit group. When the structure and relationships of gobiid genera are better known, the three may be treated as a species group in a more inclusive subgenus. The type species of *Tigrigobius* needs clarification. Fowler's (1931: 401) *Gobiosoma macrodon* is *Garmannia zebrella* and no material of *macrodon* was in the collection at the Academy of Natural Sciences of Philadelphia at the time of that paper. Thus the subgenus *Tigrigobius* is based on specimens of *zebrella* (the holotype and paratypes listed above) which were erroneously identified with *macrodon*. Since the two species are clearly to be placed together in any generic

or subgeneric alignment the problem is purely a technical one. My interpretation of the current rules of nomenclature leads me to consider *Garmannia macrodon* (Beebe and Tee-Van) as the type species.

The banding is best developed in *zebrella*, thinner in *macrodon* and somewhat reduced in *pallens*. The dark bands are wider than one-half of the light colored interspace in *zebrella* and less than one-third of the interspace in *macrodon*. *G. pallens* differs in having the second band behind the eye forming a straight line across the occiput while it is bowed in *zebrella* and *macrodon*. *G. zebrella* differs at least from *macrodon* in having the bar on the cheek remote from the end of the jaw instead of bordering it (see Fig. 1). This feature could not be determined for the faded holotype of *pallens*. The pectoral rays vary from 18 and 19 in *zebrella* to 16–18 in *macrodon* and 15–16 in *pallens*. The scalation is best developed in *pallens*, somewhat reduced in *zebrella*, while only a few scales are present in *macrodon*. The characters thus do not form a gradient. Specimens from intermediate areas are required to more fully evaluate the specific status of the three forms. Material of *pallens* is especially wanting.

Metzelaar (1919: 139) and Koumans (1931: 53) confused *zebrella*(?) with *Gobiosoma multifasciatum* and Fowler (1931: 401) related *macrodon* (= *zebrella*) to *Gobiosoma viridistriatum* (a synonym of *multifasciatum*—see Ginsburg 1933: 27). Despite this, the species of *Tigrigobius* bear no direct relation to the banded species of *Gobiosoma*. Its relations lie with *Garmannia* as discussed by Ginsburg (1933: 54). In addition to basic differences in squamation, etc. discussed by Ginsburg, *Gobiosoma multifasciatum* does not closely resemble the species of *Tigrigobius* in its pigmentation. A specimen of *multifasciatum*, USNM 117415 (1, 20) was examined and the following notes recorded. Superficially it differs from *macrodon* and its two allies in being dark colored with very discrete narrow pale bands and in having a circular dark humeral spot, which is separated from a large wedge-shaped mark by a pale band. The spot is only slightly smaller than the eye and the wedgeshaped mark (reddish in life?) begins above the gill slit and stops just short of the eye. The dark bars on the body have a narrow black border and the pelvic disc is much shorter (2.7 mm in this specimen). Fin-ray counts were: dorsal, VII, 12; anal, 10; pectoral 20–20.

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RIVER BASIN SURVEYS UNEARTH BIG PLAINS INDIAN TOWN

Remains of what probably was the biggest "town" of the Plains Indians in the Missouri Basin have been uncovered by Smithsonian Institution archeologists working in the area to be flooded by the large Oaho Dam. At the time of occupation the village consisted of earth lodges, customary habitations of the sedentary northern Plains tribes, and accessory buildings which covered an area of 4,000 by 1,500 feet. Indications are that there were some 400 dwellings and 4 large ceremonial lodges located there.

This large community, which must have had several thousand inhabitants, was located on the left bank of the Missouri River some 20 miles above Pierre, S. Dak., according to a River Basin Surveys report. It was noted and recorded during earlier preliminary reconnaissance by a group from the Missouri Basin Project of the River Basin Surveys. During the summer of 1956 testing operations were carried out by a party under the direction of Dr. Robert L. Stephenson. At that time a detailed map was made of the area and the site was staked off into 100-foot blocks. A 5-foot square test hole was excavated at each 100-foot stake along the sides of the site. In addition two trenches were dug and a house quadrant excavated. The testing was for the purpose of determining where a maximum of information could be obtained from a minimum of digging.

Dr. Stephenson returned to the site with a larger party in the summer of 1957 and with the work of 1956 as a guide began a series of excavations. This party uncovered the remains of 13

circular earth lodges and one and one-half of the four large ceremonial lodges. The house pits ranged from 25 to 60 feet in diameter and were 2 to 4 feet deep. Entrances were to the southwest, generally, and two distinct architectural patterns were observed. One was composed of closely set double rows of small, outer-wall posts. The other was composed of widely spaced single rows of outer posts with leaner posts outside of them. This suggests two closely related occupational patterns and the artifacts recovered support such a differentiation. There were certain indications that there had been an earlier occupation featuring rectangular houses, but no such structures were found in the areas excavated. Cache pits were abundant and were found to range from small holes to large bell-shaped pits 7 feet in diameter and 7 feet deep. Artifacts were abundant in the fill in such pits and an outstanding specimen, a red-stone plaque with figures of buffalos engraved on each side, came from one of them. Included in the collection are stone and bone tools, stone knives and arrowheads, several catlinite pipes, several ornaments made from marine shells, an ornament of turquoise, and different kinds of potsherds.

Skeletal materials for study by physical anthropologists were also recovered. The major occupation at the site appears to have been by the Arikara or their immediate ancestors during the period 1600 to 1750 and since little is known about the physical type of the people the skeletal material will help to fill that gap in the knowledge of the Indians of that period.